CLAIMS

What is claimed is:

1. A generator for generating an excited atomic state of a molecule, said generator comprising:

a power supply;

a pulse circuit;

an excited atomic state generating region; and

an integral electrical excitation generator and heat exchanger;

wherein said pulse circuit discharges via said electrical excitation generator a pulse to a gas in said region and thereby generates an excited atomic state of at least one species of molecule in the gas; and

wherein said integral electrical excitation generator and heat exchanger prevents the gas from heating beyond approximately 200 degrees Celsius.

2. The generator of claim 1 wherein said excited atomic state generating region comprises one or more elements selected from the group consisting of a dielectric flow tube with one or more electrodes, a microwave or radio frequency resonant gas flow cavity, a capacitively coupled radio frequency gas flow cavity, an inductive gas flow loop and at least two electrodes and at least one transformer core comprising at least one winding wherein said gas flow loop forms a secondary winding of said at least one transformer core plus at least two electrodes, and an inductive gas flow loop with at least one transformer core which comprises at least two windings, wherein said gas flow loop forms a secondary winding with said at least one transformer core.

3. The generator of claim 1 wherein said generator maintains a level of ionization of at least approximately 1012 electrons/cm3 in combination with a sustained electric field of less than or equal to approximately 10 Townsends.

4. The generator of claim 1 wherein said pulse circuit discharges pulses of between approximately 5 to 30 nanoseconds in duration.

5. The generator of claim 4 wherein said pulse circuit, after a period of producing initially more elevated pulse discharges, discharges pulses of reduced electric field lying between approximately 80 to 120 Townsends.

6. The generator of claim 4 wherein said pulse circuit discharges pulses at between approximately 25,000 to 100,000 times per second.

7. The generator of claim 1 additionally comprising pre-ionization means selected from the group consisting of burst X-ray means, continual X-ray means, photo-ionization means, metastable helium injection means, and pre-ionized plasma injection means.

8. A method of generating a plasma, the method comprising the steps of:

providing a rapidly flowing gas;

applying a pulse to the gas to over-volt the gas to an E/N value above ionization breakdown thereby forming a plasma but terminating before a glow to arc transition can occur;

applying additional pulses, above ionization breakdown of the gas, to sustain quasi-continuous ionization of the plasma; and

causing a continuous or quasi-continuous current flow to the plasma by applying an electric field comprising an E/N value less than approximately 10 Townsends.

9. A method for producing a laser beam, the method comprising the steps of:

providing a rapidly flowing gas;

applying a pulse to the gas to over-volt the gas to an electric field normalized to plasma density value above ionization breakdown thereby forming a plasma;

applying additional pulses, above ionization breakdown of the gas, to sustain quasi-continuous ionization of the plasma;

causing a current flow to the plasma by applying an electric field comprising an electric field comprising an E/N value less than approximately 10 Townsends;

contacting the plasma with a molecule of the gas to generate an excited atomic state of that molecule;

contacting the excited molecule with iodine to excite the iodine; and

lasing the excited iodine.

10. A pulse circuit for generating an output pulse, said pulse circuit comprising:

a power supply;

a single or multiple array of Blumlein lines wherein elements of each line comprise discrete coaxial or linear sections and wherein each element comprises a front end and an output end;

a switch for grounding each of said Blumlein lines simultaneously;

a series connection of the output end of each output of each Blumlein line to multiply voltage and match pulse circuit output impedence to a plasma impedence;

a snubber for truncating the output pulse from said at least one Blumlein line; and

discharge electrodes for discharging said output pulse to a gas wherein each of said discharge electrodes bound a tube configuration comprising a surface for heat exchange.

11. A laser comprising:

a gas;

a beam produced by energy carried by said gas; and

a throat, wherein said gas and said beam pass through said throat.

12. The laser of claim 11 wherein said throat comprises a converging region and a diverging region.

13. The laser of claim 11 further comprising a cavity, wherein said cavity comprises a substantially cylindrical configuration extending from said throat.

14. The laser of claim 13 wherein said cavity comprises a substantially cylindrical configuration having an increaing cross-section extending from said throat.